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Polarization Switching Dynamics of Dielectric/Ferroelectric Superlattices

Ji Young Jo[1], Rebecca J. Sichel[1], Pice Chen[1], Ho Nyung Lee[2], Eric M. Dufresne[3], and Paul G. Evans[1]

[1]Department of Materials Science and Engineering and Materials Science Program, University of Wisconsin, Madison, WI 53706
[2]Materials Science and Technology Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831
[3]Advanced Photon Source, Argonne National Laboratory, Argonne, IL 60439

The domain switching dynamics of the ferroelectrics are fundamentally interesting because the time and the length scales involved depend on the applied electric field. The nanoscale dielectric/ferroelectric superlattices are thought to possess domains with a uniform polarization penetrating the individual components. A population of domains with opposite signs exists at zero-external electric field to minimize the total energy. The dynamics of the process by which these domains are rearranged in an applied electric field have not been experimentally probed. To study the dynamics of the initial response of ferroelectric/dielectric superlattices to applied fields, we performed time-resolved x-ray microdiffraction studies of a 2($BaTiO_3$)/4($CaTiO_3$) superlattice in a pulsed electric field. The results of these experiments show that the polarization switching of the superlattice occurs at a broad range of applied electric fields, which agrees with theoretical predictions on the different coercive fields of individual component of the superlattice [1]. In addition, the strain is proportional to the applied electric field above 0.4 MV/cm when the polarization is fully switched on the millisecond timescale, but the strain is strongly non-linear up to 1.5 MV/cm on the nanosecond timescale due to the incomplete polarization switching during shorter times.

1. S. Lisenkov, *et al*., *Phys. Rev. B*, **79**, 024101, (2009).